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FLORISTIC RELATIONSHIPS BETWEEN THE NORTHERN AND SOUTHERN ARID AREAS IN AFRICA

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1. INTRODUCTION

Of the phenomena encountered in plant distribution in Africa one of the most intriguing is the recurring phenomenon of disjunction. Two outstanding examples of interrupted distribution patterns, both of great importance for the study of plant distribution in southern Africa, can be mentioned. The first and probably better known concerns the species of high mountains of Africa, and the second even more striking example is the large gap characteristic of the distribution of many arid area species which occurs in the northern as well as in the southern desert areas of Africa.

When an annual precipitation map of Africa is examined, it is striking that those areas which receive less than 500 mm per annum form two distinct regions situated north and south of the equator. By far the greater part of these regions is desert or semidesert with less than 250 mm rainfall per annum and is bordered by relatively narrow zones, adjacent to the deserts receiving 250—500 per annum (see Kers; 1969, p. 40). The intervening areas stretching over a distance of about 3000 km have sufficient precipitation to exclude most desert-adapted plants.

Seen against this background, it is surprising to find a very close relationship between the floras of these strongly isolated areas. This pattern of distribution, which mainly concerns us here, has been known to exist, both for plants and for animals, for a considerable time. Engler (1921) probably was the first to give general accont of it and mentioned approximately 60 taxa in this context. In his account he divided his examples into three groups namely:

(a) Examples of mediterranean and boreal species which have spread to South Africa, (b) Genera with some species which are typically mediterranean or mediterraneanboreal and which are also represented in South Africa, (c) Genera of which a few xerophytic species occur in Somaliland and the Sudan and which also occur in southern Africa, sometimes as vicarious species. Range (1932) and de Winter (1963) contributed more information. Volk (1964) apparently studied this relationship deeply, but unfortunately

his work was not available for use when preparing this paper and I have only seen this reference.

Additional information now gathered shows that the situation, as could be expected, is complicated and that there are numerous variations on the general patterns outlined by Engler. An analysis of the patterns will obviously not be possible until the distributions of a large number of the species have been mapped in fairly great detail.

The distribution map supplied by Kers for *Cleome angustifolia* Forssk. is a fine example of what can be achieved.

As pointed out by Van Zinderen Bakker (1966), much information of value for palaeoecological studies can be gleaned from present-day distribution patterns and contemporaneous ecology and in this respect disjunct distribution patterns are of special significance, as they may show the trends of the changes which took place. That the present day distribution patterns were produced by the interaction of past and present climates with the genetic adaptability of the species is evident. An analysis and interpretation of the patterns of distribution evolved by the different species will undoubtedly contribute to a better understanding of past climates as well as the development of these floras. Conversely, a knowledge of past climates is of great importance to the plant geographer studying present day distribution patterns.

With these aspects in mind, the author has decided to undertake the detailed mapping of the distribution of all those taxa which may contribute to our knowledge of the north-south arid disjunction. In the present paper, a brief summary of the problem is given. Lists of those taxa which may be of significance have been brought together as a preliminary to the mapping. In addition the faunal affinities between the so called Somali and South West Arid Districts are briefly discussed followed by some remarks on work on former climates in Africa.

2. TAXA COMMON TO THE NORTHERN AND SOUTHERN ARID AREAS

Under this heading all those taxa which either show a disjunct distribution pattern or are particularly well represented in the southern and northern arid areas have been classified and discussed under eight separate groupings. These groups will be dealt with under two headings namely those with disjunct and those with contiguous distribution patterns. Taxa which do not fall into the above categories have not been considered for the purpose of this paper. Obviously the lists are not exhaustive and will no doubt be much amplified as the work progresses.

2.1 Taxa with a disjunct distribution pattern

2.1.1 Families limited to the northern and Southern arid areas of Africa and in some cases also present in Asia

Up to the present only three such families have been noted. In two ca-

ses namely Neuradaceae and Wellstediaceae they represent fairly recent splits from older families namely the Rosaceae and Boraginaceae.

These families are:

	Southern distribution	Northern distribution
Neuradaceae J. G. Agardh	Kalahari- and Namib Deserts *(Neuradopsis,* one species; *Grielum,* 6 species)	Mediterranean to India *(Neurada,* one species)
Salvadoraceae Lindl.	Drier regions of Tropical and Southern Africa	Egypt, Israel, Sudan, Arabia, India, Ceylon
Wellstediaceae (Pilg.) Novák	South West Africa *(Wellstedia;* one species)	N. E. Africa and Socotra. *(Wellstedia;* one species)

2.1.2 Genera limited to the Northern arid areas of Africa, Arabia, the Middle East and North Western India — and the arid areas of Southern Africa

The distribution areas of these genera in both the main areas of dispersal are, as far as could be ascertained, more or less contiguous and hence present no further complications in the interpretation of their distribution. This group consists of eight genera and represents seven families. The genus *Citrullus* as represented by the cultivated watermelon and its primitive cultivars, is considerably more widespread in Africa than indicated in the list. The cultivars can obviously not be considered in this context and have been omitted.

These genera are:

Asclepiadaceae	Southern distribution	Northern distribution
Echidnopsis Hook. f.	Northern Cape (Namaqualand)	Arabia, Somalia, Tanzania
Cucurbitaceae		
Citrullus Schrad. ex Eckl. & Zeyh.	Namib Desert, drier areas of Southern Africa (Three species)	North Africa to India (One species)
Loasaceae		
Kissenia R. Br. ex Endl.	South West Africa	Arabia, Somalia
Fabaceae		
Lotononis (DC.) Eckl. & Zeyh.	Southern Africa (about 90 species)	Drier areas of East Africa, North Africa to Arabia & Baluchistan. (about ? 10 to 15 species)
Pedaliaceae		
Sesamothamnus Welw.	South West Africa, Angola, Northern Transvaal (Three species)	Aethiopia, Kenya, Somaliland (Two species)

	Southern distribution	Northern distribution
Poaceae		
Stipagrostis Nees	Drier areas of Southern Africa (Twenty-six species)	North Africa, Arabia, middle East, North Western India
Tetrapogon Desf.	South West Africa, Northern Transvaal, Mozambique, Rhodesia (Two species)	Egypt, Aethiopia, Somaliland, Kenya, Tanzania (about 5 species)
Sapindaceae		
Erythrophysa E. Mey. ex Arn.	Northern Cape and Transvaal (Two species)	Ethiopia (one species)

2.1.3 Genera represented in both the Northern and Southern arid areas of Africa but also more widespread, the northern distribution not contiguous

In this group 14 genera are included representing 13 families. The genera *Matthiola, Trigonella, Erodium, Linum, Secale, Cytinus* and possibly *Fagonia* could have been placed in a separate group as genera with obvious Mediterranean affinities. Of these *Linum, Secale, Cytinus* have been recorded from the winter rainfall areas of the Cape and may indicate affinities between the Mediterranean and Cape floras. The other genera are represented by species adapted to somewhat arid summer rainfall conditions in southern Africa.

The genera *Aizoon* and *Moringa,* seem typically African-Asian, whereas *Trichoneura, Thamnosma, Fagonia* have a New World distribution as well.

These genera are listed below:

	Southern distribution	Northern distribution
Aizoaceae		
Aizoon L.	South Western Cape	North Africa, Arabia, Canary Islands
Brassicaceae		
Matthiola R. Br.	Drier areas of Cape, Western Transvaal, South West Africa and Lesotho (One species)	Western Europe, Mediterranean, Central Asica, Atlantic Islands (Fifty-four species)
Fabaceae		
Trigonella L.	South Africa, central arid regions (Two species)	Mediterranean, Asia, Europe, Australia (about 70 species)
Geraniaceae		
Erodium L'Hérit.	Cape Province, Transvaal, Lesotho, Orange Free State	Europe, Australia, Central Asia, Mediterranean, South Tropical South America

	Southern distribution	Northern distribution
Linaceae		
Linum L.	Winter rainfall area of the Cape (Two species) One species extending into the Eastern Cape	Temperate and subtropical areas especially the Mediterranean (More than 200 species)
Moringaceae		
Moringa Adans.	South West Africa (One species)	North Eastern Africa, Arabia, India, Madagascar
Poaceae		
Secale L.	Winter rainfall of the the Cape (One species)	Mediterranean, Eastern Europe to Central Asia (Three species)
Trichoneura Anderss.	Namib Desert, Mozambique, Angola. (Three species)	Somaliland, Kenya, Egypt (Two species), Americas (Two species), Galapagos (One species)
Rafflesiaceae		
Cytinus L.	Winter rainfall area of the Cape (Two species) Northern Transvaal (One species)	Mediterranean, Madagascar (Four species)
Rutaceae		
Thamnosma Torr. & Frem.	South West Africa, North Western Cape	Arabia, Socotra, Southern United States
Tamaricaceae		
Tamarix L.	South West Africa and North Western Cape (One species)	Western Europe, Northern Africa to India and Northern China (about 90 species)
Urticaceae		
Forskolea L.	Angola, South West Africa, Cape. (Two species)	Canaries, Southern Spain, North Africa, Aethiopia, Somaliland, Arabia (About 4 species)
Zygophyllaceae		
Fagonia L.	South West Africa (One species)	Mediterranean, North Africa, S. W. Asia to N. W. India. — Also S. W. North America & Chile (About 39 species)
Pedaliaceae		
Rogeria J. Gay	South West Africa and N. W. Cape (Four species)	Sudan and Western Sahara (One species), Brazil (One species)

2.1.4. Species which occur in the Northern and Southern arid areas of Africa, in some instances extending into Europe, Africa and Asia

In this group, with a few exceptions, only species which are relatively uniform over their whole disjunct range of distribution have been included. In most cases, their range of variation in the whole of the distributional area, hardly exceeds that of the variation found in each of the subsidiary areas. Future monographic work will, however, be bound to change the statuts of some of the taxa.

This group contains the largest number of species, a total of 41, representing 38 genera and 16 families. The Poaceae makes the biggest contribution with 17 species. Seven families contribute two species each and six families one species each.

These species are as follows:

	Southern distribution	Northern distribution
Aizoaceae		
Corbichonia decumbens (Forsk.) Exell	Dry areas of Southern Africa	North African Desert Areas
Trianthema crystallinum (Forsk.) Vahl	South West Africa	Egypt, Sudan, Arabia, India, Ceylon
Asteraceae		
Epaltes gariepina (DC.) Steetz	South West Africa, Botswana, Northern Cape, Orange Free State, Rhodesia, Angola, Moçambique	Tanzania
Geigeria acaulis Benth. & Hook. f. ex Oliver & Hiern	South West Africa, Northern Transvaal	Kenya, Somaliland
Boraginaceae		
Trichodesma africanum (L.) R. Br.	South West Africa, Northern Cape, Northern Transvaal, Rhodesia, Angola, Moçambique	Sahara Desert, Arabia, Asia
Caryophyllaceae		
Corrigiola littoralis L.	Transvaal, Natal, Cape; Lesotho, South West Africa	Kenya, Tanzania
Polycarpon tetraphyllum L.	Cape, Orange Free State, Natal, Rhodesia	North Africa, Arabia
Chenopodiaceae		
Atriplex suberecta Verdoorn	Mainly South West Africa	Steppes of Europe (Fide Aellen)

	Southern distribution	Northern distribution
Atriplex vestita (Thunb.) Aellen	Western Cape, Orange Free State, South West Africa, Mozambique	Kenya, Tanzania
Suaeda fruticosa (L.) Forsk.	Angola, South West Africa	Mediterranean, Eritrea, Somaliland
Geraniaceae		
Monsinia senegalensis Guill. & Perr.	South West Africa, Botswana, Rhodesia, Angola	Tanzania, Kenya
Loasaceae		
Kissenia spathulata R. Br.	South West Africa	Arabia, Somalia
Poaceae		
Asthenatherum forskalei (Vahl) Nevski	Namaqualand, Namib Desert: South West Africa	North Africa
Cypholepis yemenica (Schweinf.) Chiov.	North-Western Cape, Drier Areas of the Northern Transvaal	Dry areas of Kenya and Tanzania, Somaliland
Enneapogon brachystachyus (Jaub. & Spach) Stapf	Northern Cape, Northern Transvaal, South West Africa	Dry areas of Kenya and Tanzania (Northern), Somaliland
Eragrostis curvula (Schrad.) Nees	High Rainfall and Arid Areas of Southern Africa	Kenya, Eritrea, Tanzania
Eragrostis glandulosopedata de Wint.	Northern South West Africa, Northern Transvaal	Kenya (Near Nairobi)
Eragrostis porosa Nees	South West Africa, Drier Areas of Northern Orange Free State, Transvaal and Botswana	Kenya (Maktan)
Eragrostis trichophora Coss & Dur.	Central South West Africa	North Africa, Ethiopia
Fingerhuthia africana Lehm.	South West Africa, South Africa	Asia, Afghanistan, Arabia
Odyssea paucinervis (Nees) Stapf	Drier Areas of South Africa and South West Africa	Sudan, Ethiopia, Kenya
Schismus barbatus (L.) Thell.	Drier areas of the Cape, South West Africa	North Africa
Sphenopus divaricatus Reichb.	North-Western Cape	Algeria: North Africa
Stipa capensis Thunb.	North-Western Cape	North Africa
Stipagrostis obtusa (Del.) Nees	North-Western Cape and South West Africa	North Africa
Triraphis pumilio R. Br.	Namib Desert: South West Africa	Arabia

	Southern distribution	Northern distribution
Tetrapogon tenellus (Roxb. Chiov.	S.W.A., Northern Transvaal, Southern Parts of Rhodesia	Somaliland, Tanzania, Kenya
**Trichoneura arenaria* (Hochst. & Steud.) Ekman		Egypt, North Africa
**Trichoneura eleusinoides* (Rendle) Ekman	South West Africa	
Malvaceae		
Althaea ludwigii L.	South West Africa, Northern Cape	N. Africa
Malva aegyptia L.	Northern Cape (Kenhardt)	N. Africa
Mesembryanthemaceae		
Mesembryanthemum nodiflorum L.	Western and N. Western Cape	North Africa, Arabia, Canary Islands, Madeira
Nyctaginaeceae		
Boerhavia repens L.	South West Africa, North Western Cape, Botswana	Somaliland, Kenya, Egypt
Commicarpus squarrosus (Heim.) Standl.	South West Africa	Somaliland, Arabia
Orobanchaceae		
Orobanche mutelii F. Schultz	South Africa	Mediterranean, Persia, Somaliland, Ethiopia
Pedaliaceae		
Rogeria adenophylla J. Gay ex Del.	Namib Desert: South West Africa	North Africa, Somaliland
Sesamum alatum Thonn.	South West Africa, Drier Parts of Rhodesia, Moçambique, Botswana and Transvaal	Kenya, Ethiopia, Sudan, Senegal, Gold Coast, Nigeria
Resedaceae		
Oligomeris linifolia (Vahl) Macbr.	Namib Desert	Arid Regions of Northern Hemisphere: North America, Northern Africa to North-Western India
Scrophulariaceae		
Anticharis linearis Hochst. ex Asch.	South West Africa, Botswana, Northern Transvaal, Rhodesia	

* Probably conspecific

	Southern distribution	Northern distribution
Sterculiaceae		
Hermannia modesta (Ehrenb.) Mast.	Drier Parts of Southern Africa	North Africa, Arabia
Sterculia africana (Lour.) Fiori	South West Africa, Rhodesia*, Zambia*, Malawi*, Moçambique	Egypt, Sudan, Arabia, India, Ceylon

* only in the hotter and drier parts

Zygophyllaceae		
Zygophyllum simplex L.	Northern Cape, South West Africa	Northern Deserts to India

2.1.5. Species which are represented in the Northern and Southern arid areas by distinct subspecies or varieties, one in the North and one in the South

Only three examples have been listed but this is almost certainly an indication of lack of monographic work on the species concerned rather than a true indication of the status of the flora as a whole. This situation must also be interpreted against the possibility that some of the species listed under 2.1.4. may be changed in status should they be subjected to monographic studies.

According to Bourreil, *Stipagrostis hirtigluma* (Steud.) De Wint. shows a tendency in North Africa to segregate into more or less similar varieties as are recognised by De Winter (1965) from Southern Africa, but so indistinctly as to make subdivision impractical. The author has on the other hand only with hesitation accepted the var. *hirtigluma* as present in South Africa, most of the material belonging to the two other varieties which are well developed, and reasonably distinct.

The work of Kers (1969) on *Cleome angustifolia* Forssk. has greatly clarified the taxonomy of this species and should serve as an example of what may happen in other species subjected to intensive study.

These species are:

	Southern distribution	Northern distribution
Capparaceae		
Cleome angustifolia Forssk.		
ssp. *angustifolia*	—	Ethiopia, Arabia, Kenya
ssp. *petersiana*	Drier areas of southern Africa	Drier areas of Eastern Africa
ssp. *diandra*	Drier areas of Southern Africa	—

	Southern distribution	Northern distribution
Poaceae		
Stipagrostis ciliata (Desf.) de Wint. var. *ciliata*	—	North Africa
var. *capensis*	Drier areas of South- and South West Africa	—
Stipagrostis hirtigluma (Steud.) de Wint. var. *hirtigluma*	Areas marginal to the Namib Desert	Sinai to Aethiopia, Arabia, India
var. *pearsonii*	Central plateau and marginal desert areas of South West Africa	—
var. *patula*	Central plateau of South, N. Transvaal, Rhodesia	—

2.1.6. Vicarious, closely related species, one confined to the Northern, the other to the Southern arid areas

These species pairs are of particular interest since it is logical to conclude that they must have originated from some common ancestral species during a period when the northern and southern deserts were connected. There is a need for intensive study of these vicarious species before any conclusions can be drawn.

These species are as follows:

	Southern distribution	Northern distribution
Caralluma peschii Nel	South West Africa	—
Ritidocaulon subscandens	—	Ethiopia, Somalia
Huernia zebrina N. E. Br. *H. transvaalensis* Stent.		
H. insigniflora C. A. Maass	Northern Cape (Namaqualand)	—
Huernia somalica N. E. Br.	—	Somaliland
Stapelia revoluta Mass.	Namaqualand	—
Stapelia prognatha Bally	—	Somalia
Boraginaceae		
Heliotropium hereroense Schinz	South West Africa	—
Heliotropium rariflorum Stocks	—	Kenya, Somaliland
Poaceae		
Stipagrostis uniplumis (Licht.) de Wint.	Arid and semi-arid Western Southern Africa	—

	Southern distribution	Northern distribution
Stipagrostis papposa (Trin. & Rupr.) de Wint.	—	North Africa
Stipagrostis foexiana (Maire & Wilc.) de Wint.	—	North Africa
Tricholaena capensis (Licht. ex Roem. & Schult.) Nees	North-western Cape and South West Africa	—
Tricholaena teneriffae (L. f.) Parl.	—	Somaliland
Sterculiaceae		
Sterculia rogersii N. E. Br.	Northern Transvaal, Natal, Swaziland	—
Sterculia arabica (R. Br.) Anderss.	—	Arabia (Aden)
Wellstediaceae		
Wellstedia dinteri Pilg.	South West Africa	—
Wellstedia socotrana Balf. f.	—	Socotra & N. E. Africa
Zygophyllageae		
Seetzenia africana R. Br.	South Africa: Cape	—
Seetzenia orientalis Decne	—	North Africa

2.2. Taxa with apparently contiguous distribution patterns but particularly strongly represented in both the Northern and Southern arid areas

Examples under this heading have for convenience been divided into two subdivisions (a) genera and (b) species. No families which as a whole exhibits this characteristic distribution were noted.

2.2.1. Genera strongly represented in the Northern and Southern arid areas but with some species occuring in the intervening areas

When investigating the distribution of genera with the purpose of listing those showing a distinct disjunction, a number of genera which showed an apparently continuous dispersal were noticed. Nevertheless some of these were very similar in the general distribution pattern to those showing disjunction, except for a rather narrow belt which links the two areas. This belt seems to coincide with the "subarid areas" linking the northern and southern deserts and has been termed the "Arid-corridor" by some authors (cf. Van Zinderen Bakker 1967 p. 76). No full list of these genera was prepared at this stage and the following examples will suffice.

Commiphora Jacq. This genus is strongly represented in both northern and southern deserts and the majority of species inhabit desert or semi-desert areas. A few species occur in less dry habitats i. e. *C. harveyi* (Engl.) Engl. and *C. woodii* Engl. which occur in high rainfall forests on the east coast of South Africa and also extend into tropical Africa. Such species, and others less tied to conditions of extreme aridity *C. neglecta* Verdoorn, will probably form a connection link between the northern and southern areas of dispersal occupied by the genus may prove to be contiguous. Other genera which probably have similar patterns of dispersal are *Adenium* Roem. & Schult. with 15 species dispersed in tropical and sub-tropical areas in Africa and Arabia. Most of them are stem succulents with a xerophytic habit.

Zygophyllum L. This genus is well represented in Africa especially in Southern Africa and also in the Mediterranean, Central Asia and Australia.

Tribulus L. A genus of about 20 species of which five are Southern African. There are centres of development in both the northern and southern arid areas but species occur in the intervening areas.

Pterodiscus Hook. This genus has about 15 species which are confined to tropical and Southern Africa and are mainly concentrated in sub-arid areas.

2.2.2. Species widespread in both the Northern and Southern arid areas but also dispersed in the intervening areas

The following species probably are best placed under the above heading until their distribution has been studied in detail. *Cassia italica* (Mill.) Lam. ex Andr., *Cleome monophylla* L., *Cissus quadrangularis* L., *Abutilon ramosum* (Cav.) Guill. & Perr., *Commicarpus pentandrus* (Burch.) Heim., *Maerua angolensis* DC., *Glinus lotoides* L., *Salvadora persica* L., *Sporobolus spicatus* Kunth, *Pegolettia senegalensis* Cass.

3. AFFINITIES BETWEEN THE FAUNA OF THE NORTHERN AND SOUTHERN ARID AREAS OF AFRICA

Van Zinderen Bakker in Palaeoecology of Africa (1967) brought together several short articles on this subject. On insects Koch (1965) pointed out that "among animals the coleopterous Tenebrionidae appear to be paramount to other groups, in that some highly xerophilous subfamilies (such as Adesmiini, Zophosini, Tentyriini, Epigtragini) exhibit a great discontinuity in their recent range of distribution and are distinctive for deserts, such as the Namib, Sahara, the Arabic Rub'al Khali and, in part, also the Asiatic Gobi".

On birds Winterbotton (1967) states as follows: "The resemblances of the bird fauna of the north-east and south-west have long attracted attention. These resemblances exist at all levels. Thus the two Districts share certain genera . . . . . which are virtually confined to these two areas. Then there are nearly 30 species or species-pairs common to the north-east

and south-west . . . . . Nevertheless, each of these District has genera which are peculiar to it and do not occur either in the other or anywhere else".

Based on the above observations WINTERBOTTOM suggests: (1) that a corridor of desert or semi-desert country linked the Somali Arid and South West Arid Districts some time in the past (ii) that because of the different degrees of differentiation shown by the faunal links it is likely that such conditions pertained more than once (iii) that in view of the otherwise considerable differences between the faunas extending to the presence of unique genera, such connection was probably short in time and may even have been incomplete.

4. STUDIES ON THE FORMER CLIMATES OF AFRICA

COETZEE and VAN ZINDEREN BAKKER (1970) recently pointed out that relatively little is known about the past climates of Africa whereas an impressive volume of data is now available on the northern hemisphere. Furthermore, there is evidence that annual temperature drops of between 13°—15°C occurred in the Northern Hemisphere during the Quaternary, which, according to COETZEE et al., "shows clearly that even by inference only, it can be concluded that big changes must also have taken place in the Quaternary ecology of Africa". That this statement is well founded is clear from the outline of work done by FLINT (1959) and others as well as of their own work. Pollen studies by VAN ZINDEREN BAKKER and COETZEE were mainly undertaken on the East African Mountains but extended also to Abyssinia, Angola, South Africa, and even to Marion Island in the subantarctic. These studies indicated that on the high mountains of East Africa, shifts in vegetation belts had taken place on a number of occasions. These shifts of vegetation are correlated with changes in temperature, a decrease in temperature causing a downward shift, and rising temperature a corresponding upward shift, of the tree line. It has been proved that decreases in temperature have occurred sychronously on a world wide scale and probably were of cosmic origin. Nevertheless they were often very different as far as their influence on rainfall was concerned. These worldwide decreases in temperature would have had a global effect on the climatic systems. Exactly what the effects on the climate were needs further study. However, that fluctuation of rainfall did indeed occur seems undeniable.

5. CONCLUSIONS

From the lists of taxa presented by various other authors and here summarized and expanded it is clear that a very strong floristic resemblance exists between the northern and southern arid floras of Africa.

The explanation of the strong floristic similarities by a former arid corridor which connected these areas or in the view of WINTERBOTTOM, the exi-

stence of connections at various intervals, are supported by the parallel situation found in plants and birds. Connections exist at all levels from the subspecific, specific to the generic and even the family level, with, in addition, a high endemism in common to both areas or occasionally with mutually exclusive endemism in related taxa in these areas. Nevertheless, it will have to be established whether this situation could not have arisen even if a connection had only once existed, but on a considerable scale as well as for a considerable time followed by more tenuous connections. The strong floristic links seem difficult to explain by an arid corridor only.

The existence of an "arid corridor", which made the migration of species possible at various intervals in time, is also supported by palynological and other studies which indicate that fluctuation in precipitation occurred during the Quaternary.

To further our knowledge of this phenomenon, it is necessary to do detailed mapping of the distribution of the taxa common to both floras, but expecially those with disjunct distributions. In order to achieve this, taxonomic studies of those taxa of uncertain status will have to be undertaken first.

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